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Important Considerations in Pear Production

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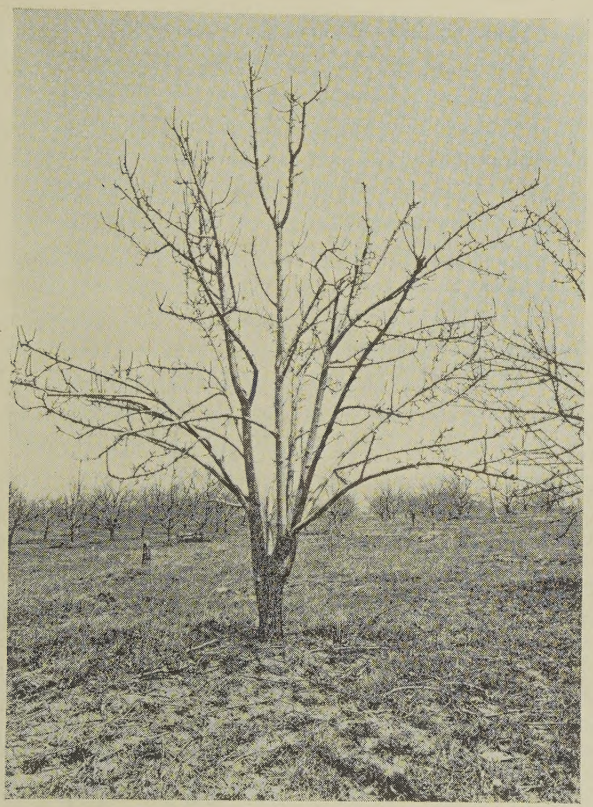

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IMPORTANT CONSIDERATIONS IN PEAR PRODUCTION

PEAR CULTURE

G. W. Peck

Pear trees, to be productive, should be vigorous, making a terminal yearly growth of from 6 to 10 inches. If the growth falls much below this, they rarely produce full crops. When stimulated by cultivation or fertilizers, or by both, to the extent that the new growth is excessive and continues into late July, conditions are made favorable for blight infection. Many pear orchards in the past have suffered severely from blight, owing largely to overstimulation and succulent late growth, and to failure to control insects which aid in the dissemination of the blight bacteria. As a result of this severe damage, many growers have gone to extremes in reducing vigor in their trees. While this procedure has, in many instances, been somewhat effective in reducing the ravages of blight, it has also reduced yields to the point where the orchards have ceased to be profitable.

Certainly, good yields of fruit year after year, even though a few trees or parts of trees may be lost by blight, are far more profitable than are occasional partial crops with little or no loss of trees. It is probable that trees maintained sufficiently vigorous to be consistently productive may be somewhat more subject to blight damage than are those low in vitality. However, by judicious management, pear trees may be kept in good production and suffer little more than those non-productive and low in vitality.

Cultivation

In so far as it is possible, conditions should be made favorable for an early leaf and terminal growth. Such a condition is conducive to the setting of fruit on blossoms that open in the spring and to the formation of fruit buds for the following year. To accomplish this, cultivation, if it is practiced, should be started just as early in the spring as the ground is workable. By early working of the soil, grass and weed growth is destroyed and conditions are made favorable for liberating nitrogen and other plant foods available for the tree. Cultivation of the soil should be discontinued by June 1 or very soon after, and a cover crop should be sown. As the cover crop becomes established, it competes with the tree for available plant foods and moisture, and serves to check and harden the succulent wood growth.

FIGURE 1. A YOUNG SECKEL ORCHARD THAT IS MAKING EXCELLENT GROWTH
The soil is well supplied with organic matter and well drained. The gentle slope provides good air drainage

Fertilizers

Mature trees low in vitality and with soil low in organic matter might well receive a light application of nitrate of soda or some such fertilizer in addition to cultivation and the growing of cover crops. On such soils a light dressing of stable manure could be used with safety if applied in the fall or the early spring. Nitrate should be applied from two to three weeks in advance of the blooming time, at the rate of from 2 to 4 pounds per tree. For similar trees in sod, it would be necessary to use from 4 to 7 pounds per tree, depending on the size and the condition of the tree. As soon as normal vigor is reestablished, one should exercise good judgment in the amounts of nitrogen and stable manure to use in subsequent years to prevent overstimulation, which results in late-maturing terminal growths liable to blight damage.

Use stable manure with caution. Heavy applications of stable manure, either in cultivated or in sod orchards, tend to prolong succulent terminal growth beyond the time when it should normally be matured, thus increasing conditions favorable for blight. For most conditions, a

quickly available nitrate fertilizer is safer than manure. For orchards very low in vitality and with the soil depleted in organic matter, it is probable that a fairly heavy application of stable manure during late fall or very early spring could be used with comparative safety. When such orchards have been restored to normal vigor, a quickly available nitrate fertilizer may well be substituted for the manure. In a general way one is able to control growth conditions in an orchard to better advantage with nitrate of soda or some such fertilizer than with stable manure.

Soil drainage

Good soil drainage is of the greatest importance if satisfactory yields are to be obtained. Orchards on low, poorly drained ground, or on slopes where the water table remains near the surface during the spring and throughout wet periods, usually are low in production and are unprofitable. Such orchards seldom respond sufficiently, even to the best orchard practices, to make them paying investments. Where conditions permit, a system of deep dead furrows or open ditches may be found very beneficial in carrying away surface water and in lowering the water table, for the pear roots can then function much earlier in the spring and to better

FIGURE 2. A MATURE PEAR ORCHARD THAT LACKS VIGOR

Orchards that lack vigor as a result of a wet soil condition or a lack of care are seldom profitable

advantage throughout the year. Such drainage, properly maintained, together with good cultural methods, might well be considered as a means of increasing the production in some orchards. Tile drainage, although not always entirely satisfactory, would be of great value in some plantings in increasing yields. Under present economic conditions, however, the expense of installing such a system would be justified in comparatively few orchards.

Cross-pollination

In many pear orchards unsatisfactory production is doubtless due to a lack of cross-pollination. Practically all pear varieties are self-sterile or nearly so, and require the pollen from some other variety if they are to be productive. Two of the important commercial varieties, Bartlett and Seckel, are intersterile. In plantings of these two varieties or in orchards of a single variety, consistently good yields cannot be expected until a certain proportion of the trees have been top-worked to some other variety, such as Bosc, Kieffer, Anjou, or Clapp Favorite. A detailed discussion of the requirements for cross-pollination and the methods of top-working may be found in several bulletins of the Cornell University Agricultural Experiment Station.

Pruning

When pear trees have reached mature bearing age, a certain amount of pruning becomes necessary. Many of our pears have a very upright habit of growth. To prevent their becoming so high that the control of insects and diseases and the harvesting of fruit are performed with difficulty, some heading back may well be done to advantage. It is usually advisable not to lower the top until the trees have reached the desired height. Frequently, under heavy loads of fruit, many of the upright limbs in comparatively young trees will be bent over, which eliminates the need for heading back these limbs. Those that persist in the upright growth may be cut back, preferably to strong side branches. It is advisable to do such pruning while the upright portions to be cut away are comparatively small. If allowed to grow 3 or 4 more feet beyond the desired height, it will be necessary to make rather large cuts when lowering the tops. As a result of large cuts the growths are likely to be vigorous, succulent, and mature late in the season, making conditions favorable for blight infection.

In the mature tree, light, well-distributed pruning is usually desirable. It may not be necessary to prune each year. However, sufficient pruning should be done to admit sunlight to all fruiting wood in the tree. When mature pear trees are allowed to go for a number of years without pruning, so many small limbs may develop that many of the fruit spurs become

so shaded that they lack vigor and production. When this condition exists in a tree, too large a proportion of the fruit is small and lacks good color. Under such conditions, too, it is extremely difficult to control psylla and other insects and diseases. With pears, better results are obtained by doing a moderate amount of pruning at one time than to prune severely, for heavy pruning may result in succulent late growths, which, as already stated, make conditions favorable for blight. The pruning should be confined to comparatively small cuts well distributed through the bearing area. Large cuts usually induce water-sprout growths near the cuts and thus increase danger from blight. When pruning during late fall or early spring, particular care should be exercised to cut well below blight-infected areas to avoid spreading the disease with pruning tools. The best time for such work is during the winter months when the trees are entirely dormant.

With the variety Kieffer, it is often necessary to prune severely each year in order to obtain a fruit of satisfactory size. The pruning consists of the removal of much of the one-year wood and the spurring back of those growths allowed to remain to two or three buds. Pruned in this way,

FIGURE 3. KIEFFER PEAR TREES THAT HAVE BEEN PRUNED

In order to obtain good size, the Kieffer in many orchards requires rather severe annual pruning

a vigorous spur system is developed in the tree. Well-distributed removal of clusters of spurs, and sometimes the heading back of willowy limbs, may be necessary from time to time to maintain good production and size. The Kieffer is not so subject to blight as are most of our pear varieties, so this practice may be done with comparative safety.

Future plantings

The grower who contemplates increasing his pear plantings should give most careful consideration to the selection of soil for such an increase. In a general way pears seem to prefer the medium-heavy soils. However, some of the best orchards are located on sandy and gravely loams. Doubtless good soil drainage is of far greater importance than is any special soil type. A medium clay loam with a subsoil providing adequate drainage, a soil which may be worked comparatively early in the spring and on which water stands but a short time after heavy rains, would be considered as ideal for pears.

An exposed site, one that provides good air circulation, facilitates greatly in the control of insects and fungous diseases. Close planting is a mistake too frequently made. Better results may be expected by giving the trees more room. A mimimum planting distance would be 20 by 20 feet, while 22½ or even 25 feet might well be considered, and particularly so for the large-growing varieties.

At the present time, Bartlett, Seckel, and Bosc seem most desirable for commercial plantings. Gorham, Ewart, and Phelps are three new varieties well worthy of trial. Planting plans should provide for adequate pollination.

PEAR INSECTS AND THEIR CONTROL

C. R. CROSBY AND W. E. BLAUVELT

A practical spray schedule for pears in New York must be built around the control measures required for pear psylla, since this pest is by far the most serious of any to the pear crop.

Spray outline for pears

Two methods of control are used against psylla. One is based on a cluster-bud application of lime-sulfur 1–8, the other on a dormant application of lubricating-oil emulsion.

When lime-sulfur is used for psylla

Cluster-bud spray (When the blossom buds have separated in the cluster, for Bartlett; when they begin to separate, for Kieffer)

Lime-sulfur	11 gallons
Water to make	100 gallons

The cluster-bud spray is directed against the eggs of the psylla. It will also kill scale and will prevent early infections of pear scab. For effective results, it is absolutely essential to cover the underside of the branches from below.

First-nymph spray (About a week after the petals fall)

Copper sulfate	2	pounds
Lime	30 to 40	pounds
Lead arsenate	3	pounds
Nicotine sulfate	1	pint
Water to make	100	gallons

This first-nymph spray is sometimes called the *calyx spray,* but it is more effective if delayed until most of the psylla eggs have hatched. This is normally about a week after the petals fall.

In addition to killing the young psylla nymphs, this spray is effective against codling moth, false tarnished plant-bug, and scab.

If dust is used for psylla control, a 2-per-cent-nicotine-lime mixture is indicated. This is effective only if delayed until the majority of the psyllas are in the later nymph and adult stages. For the control of scab and codling moth, 90–10 sulfur–lead-arsenate dust is indicated.

Summer sprays (When psylla becomes threatening)

The same materials are used in the summer sprays as are indicated for the first-nymph spray. Applications made shortly before harvest should contain 1 pint of nicotine and from 3 to 5 pounds of soap for each 100 gallons of the spray mixture to avoid residue on the fruit.

If dust is used for psylla control, a 2-per-cent-nicotine-lime mixture is indicated. For the control of diseases and chewing insects, a 90–10 sulfur–lead-arsenate dust is indicated.

When an oil spray is used for psylla

Dormant spray (Early in the spring when the flies appear on twigs and are ready to lay eggs)

Lubricating-oil emulsion diluted to contain 3 per cent of oil.

This dormant spray is effective against psylla and scale.

Pre-blossom spray (When the blossom buds begin to separate in the cluster)

Lime-sulfur	2½ gallons
Water to make	100 gallons

or

2–40–100 bordeaux mixture

This pre-blossom spray is made to prevent scab infection and needs to be applied only in orchards where this disease is feared.

Calyx spray (Soon after the petals fall)

Copper sulfate	2 pounds
Lead arsenate	3 pounds
Hydrated lime	30 to 40 pounds
Water to make	100 gallons

The calyx spray is effective against codling moth and scab.

If the false tarnished plant-bug is present, or if psylla has not been controlled by the oil spray, add 1 pint of nicotine to the above formula.

Summer sprays (When psylla becomes threatening)

Follow the directions given for the lime-sulfur schedule (page 9).

Pear psylla

(*Psylla pyricola* Förster)

The pear psylla is by far the most important insect pest of the pear in New York State. It is most serious in the commercial pear-growing districts, and in some has been so destructive and so difficult to control as to render commercial pear-growing largely unprofitable. The insect is not equally serious in all orchards, but is more of a problem in large plantings and in sheltered orchards. In season when the psylla is especially abundant, it is a serious problem in practically all orchards. Where it is not controlled, it often causes early defoliation and loss of crop, and so weakens the trees that they suffer winterkilling and a reduction in the succeeding year's crop.

The adults pass the winter under flakes of bark on pear and other near-by trees, and in trash and other shelter along adjacent fences and hedgerows. The psylla adults are commonly known as "flies" and have been aptly likened to tiny cicadas. They are about 1/10 inch long and are dark reddish brown in color, and have relatively large, transparent wings which slope roof-like over the abdomen. Their legs are adapted to jumping.

The flies emerge from their hibernating quarters during sunny days in early spring when the temperature is above 40° F. If the weather continues warm, they crawl out on the smaller branches and spurs, and in a few days the females begin to lay eggs. Later, intermittent cold spells may cause the adults to return to shelter and thus interrupt and prolong the egg-laying period. In normal seasons most of the eggs have been deposited by the time the blossom buds separate in the cluster, but in cool seasons egg laying may continue through the blossoming period. The small, elongate eggs are laid end to end in crevices around the buds, mainly on the underside of the smaller branches and fruit spurs and later on the

lower surface of the opening leaves along the midrib. Although white in color when laid, the eggs soon change to lemon-yellow, deepening to orange as they near hatching. The eggs hatch in from nine days to four weeks, depending on the temperature. The majority of the eggs hatch during the blossoming period, and in normal seasons hatching is practically completed by about a week after the petals fall.

The newly hatched nymphs are so small as to be hardly visible to the unaided eye. They migrate to the opening buds and locate at the bases of the leaf petioles and the fruit stems, where they pierce the tissue with their bristle-like mouth parts and suck out the plant juices. They grow rapidly, passing through five immature stages and becoming winged adults at the fifth molt. During the first three stages, the nymphs are yellow in color and are covered by a sticky excretion called "honeydew." The fourth and fifth stages are known as "hardshells," and during these stages relatively little honeydew is secreted. During the fourth stage the body is marked with blue shading to brown in the fifth and with dark brown. The summer flies are smaller and lighter in color than the overwintering adults.

The completion of the life cycle requires about a month, and there are three or four generations a season. Each female lays about 500 eggs. Under favorable conditions the insect may increase to tremendous numbers from even a few overwintered flies. The summer broods overlap to a considerable extent, so that after the first generation all stages may be present at the same time.

The feeding of the nymphs dwarfs the leaves, produces brown, dead areas, and in severe instances causes the foliage to drop prematurely. Foliage injury results in undersized, poor-quality fruit, prevents normal fruit-bud formation, and weakens the tree. Early defoliation is often followed by winterkilling of branches and by a reduction in the crop for several succeeding years. The fruit is often badly stained and reduced in market value by a sooty fungus which grows in the sticky coating of "honeydew" excreted in large quantities by the nymphs.

Control

The pear psylla is a very difficult pest to control, and no single treatment can be relied upon when psylla is abundant. The system that has been most generally and successfully employed under New York conditions consists of: (1) an application known as the *cluster-bud spray* of lime-sulfur, 1–8, just before blossoming, to kill the eggs laid by the overwintered flies, (2) an application of a nicotine spray shortly after petal-fall, to kill the newly hatched nymphs of the first generation; and (3) applications later of nicotine sprays if psylla becomes abundant during the summer. In average years, thorough and well-timed cluster-bud and first-nymph sprays usually give commercial control for the season.

The cluster-bud spray, if applied thoroughly and at the proper time, is very effective in normal years, since the great majority of eggs have then been deposited and have developed to the stage where they are readily susceptible to lime-sulfur, 1–8. In cool seasons the spray is somewhat less effective, for a considerable number of eggs may be deposited after the latest date at which the spray can be safely applied. But even under these conditions the cluster-bud spray is worth while whenever psylla is a serious problem, since it prevents considerable injury that would otherwise occur before the first-nymph spray. It also makes the nymph sprays more completely effective by killing early laid eggs and early hatched nymphs. As a result, most of the psyllas left on the tree are in the more susceptible early nymph stages when the nymph spray is applied. To be most effective, the cluster-bud spray should be applied at as late a date as possible before blossoming.

Slight foliage injury is likely to result from the use of lime-sulfur, 1–8, at the cluster-bud stage, but there is practically no danger of injuring the flower buds. The Bartlett variety has but little leaf area exposed just before blossoming, while with the Kieffer the leaves are much more expanded. To avoid danger of burning, it is well to spray the Kieffer variety just as the buds begin to separate in the cluster. Seckel and Clapp can be safely treated a little later; Bartlett, Bosc, and other varieties should be sprayed when the buds are fully separated, the operation being completed just before blossoming. If overwintered flies are still numerous and laying eggs, it may sometimes pay to add 1 pint of nicotine to each 100 gallons of the spray mixture.

Only a very thorough application is worth while, and careless spraying is certain to result in failure. A majority of the psylla eggs are deposited on the underside of the spurs and the smaller branches and on the water sprouts, so that the most effective method is spraying from the ground.

The first-nymph spray is especially necessary where no cluster-bud spray is applied, and is also advisable as a supplementary application to kill the nymphs that have hatched from the eggs missed in the earlier spray or laid after the spray was applied. At this time psyllas are relatively few in numbers and are mostly in the susceptible nymph stages. Psylla increases very rapidly, and later sprays are less effective owing to the overlapping of broods and the presence of eggs which are not susceptible to nicotine.

The first-nymph spray should be applied when practically all of the eggs laid by the overwintered flies have hatched but before a large number of early hatched nymphs have reached the adult stage. This usually occurs about a week after the petals fall but depends entirely on the

seasonal development of the psylla. The time can be accurately determined only by close observation of psylla development. The following spray mixture is used:

Copper sulfate	2 pounds
Hydrated lime	30 to 40 pounds
Lead arsenate	3 pounds
Nicotine sulfate	1 pint
Water to make	100 gallons

A driving spray with considerable pressure should be employed, so as to force the spray between the bases of the leaf petioles and the fruit stems, where many of the nymphs are sheltered. Thorough spraying is essential.

In seasons of abundance, or where the early sprays are omitted or carelessly applied, a later application may be necessary. When considerable amounts of "honeydew" indicate that psylla is abundant, a spray should be applied in July at the time when most of the second brood are in the early nymph stages.

Sometimes psylla becomes abundant in early August shortly before fruit picking, and threatens to smut the crop. When this occurs, a combination of from 3 to 5 pounds of soap and 1 pint of nicotine sulfate to 100 gallons of water may be used instead of the lime and the nicotine, to avoid residue on the fruit. This mixture is very effective and can safely be applied until within a few days of picking.

Another schedule which is sometimes followed with considerable success, and which is somewhat less expensive, consists of the application of a dormant oil spray when the flies appear in early spring. This is followed when necessary by summer-nymph sprays, as in the other schedule. Lubricating-oil emulsion is used but is diluted to contain 3 per cent of oil when applied. This spray can be prepared from commercial stock emulsions or from Diamond Paraffin lubricating oil emulsified in a spray tank. The spray should be applied on sunny days in March or early April when the flies appear in numbers on the branches but before many eggs are laid.

Although the killing of flies is important, much of the effectiveness of the spray results from the coating of oil residue left on the tree. This repels the flies so that fewer eggs are deposited, and also kills many of the newly hatched nymphs as they attempt to crawl over it to the leaves.

Whenever psylla becomes abundant during the summer, nymph sprays are applied as in the other schedule. (See spray schedule, page 9.)

The principal difficulty in using the oil schedule lies in the danger of injuring the trees. This is most noticeable in the case of trees weakened by winter injury or by previous attacks of the pear psylla. On weak

trees the oil treatment should not be continued for more than one or two years in succession. If the trees are vigorous, the orchard should be carefully watched; when oil injury is observed, the treatment should be discontinued.

False tarnished plant-bug

(*Lygus communis* Knight)

False tarnished plant-bug is present in occasional orchards throughout the State, and may cause a large proportion of the fruit to become knotty and deformed.

The insect passes the winter in the egg stage in the bark of the smaller branches. The eggs hatch during the blossoming period, and the young nymphs, after feeding for a time on the expanding leaves, attack the fruit as soon as it sets. In feeding, they puncture the fruits with the bristles of the beak, and suck out the plant juices. The tissue around the puncture becomes hard and gritty. Growth at that point is retarded, and a deep pit or dimple develops. Badly punctured fruits are not only deformed but also dwarfed. The nymphs are at first pale in color but become greenish after the first molt. They pass through five immature stages and become mature about the middle of June. The adult is about ¼ inch in length and is light brown in color. There is only one brood a year. Most of the injury caused by the nymphs is during June while the fruits are still quite small.

Control

The nymphs can be killed by a thorough application, made soon after the petals have fallen, of nicotine sulfate, 1 pint in 100 gallons of water, in which 3 to 5 pounds of soap has been dissolved. The first psylla-nymph spray, containing nicotine sulfate and hydrated lime (page 9), is also effective, and if this is used, no extra application is necessary.

Codling moth

(*Carpocapsa pomonella* Linnaeus)

The codling moth is an important pest of the pear and sometimes causes serious injury where control measures are not used. Because of the tougher character of the skin, a larger proportion of the larvae are thought to enter through the calyx cup than in the case of the apple.

Control

The first spray for the control of codling moth is applied shortly after the petals have fallen, and contains 3 pounds of lead arsenate for each 100 gallons of the spray mixture. The arsenical is usually added to the first-nymph spray (page 9). If psylla is not a pest in the orchard, the arsenical should be used with a bordeaux mixture containing 2 pounds of copper

sulfate, from 30 to 40 pounds of hydrated lime, and water to make 100 gallons of spray.

If a second psylla-nymph spray is applied in July, lead arsenate, 2½ pounds for each 100 gallons of the spray mixture, should be added for the control of codling moth.

Quince curculio

(*Conotrachelua crataegi* Walsh)

In a few scattered orchards in the Hudson Valley, the quince curculio sometimes causes considerable injury to pears. Fruit injured by the feeding and egg-laying punctures of the curculio becomes knotty and deformed.

Control

Infested orchards should be sprayed with 2½ pounds of lead arsenate and 20 pounds of hydrated lime in 100 gallons of water, as soon as the beetles emerge from the ground. The time of emergence may vary considerably from year to year, but in the Hudson Valley it is usually during the first week in June. The time of appearance of the beetles can be determined by jarring trees at intervals, beginning in late May.

Pear midge

(*Contarinia pyrivora* Riley)

The pear midge is now a major pest of the pear in the Hudson Valley, and also causes serious injury in occasional orchards in Genesee County. In badly infested orchards the entire crop of certain varieties may be destroyed. All varieties are attacked, but Lawrence is the most seriously injured and Kieffer the least.

The adult pear midge is a small mosquito-like fly, distinguishable from other midges by its more delicate build and unusually long legs. They usually emerge from the ground at about the time the blossom buds of Clapps Favorite are separating in the cluster, and they remain on the trunks and branches until the buds have swollen and begun to show color. The female then moves to the buds, and by means of her long, flexible ovipositor lays her eggs inside the unopened blossom, often depositing from 20 to 30 in a single bud. These hatch in about a week, and the tiny larvae work their way into the ovary and hollow out a large cavity in the center of the developing fruit.

Infested fruits are at first larger than normal but later become stunted and deformed. When full-grown, the larvae either drop to the ground through cracks which develop in the side of the fruit, or they drop with the fruit. They usually pupate soon after entering the soil and remain in this state until the following spring.

Control

The pear midge can be controlled by a contact spray to kill the adult midges before they lay their eggs. The spray should be applied when the individual blossom buds are separating from one another in the cluster, or as soon thereafter as the midges appear. The application must be completed without delay, since the time for effective spraying is often only a day or two. The entire tree, including the trunk, should be thoroughly covered and all the trees in the orchard sprayed. Nicotine sulfate, 1 pint in 100 gallons of the spray mixture, is added to a solution of lime-sulfur 1–8 if psylla is to be combated at the same time or to lime sulfur 1–40 if for pear midge alone.

Pear thrips

(*Taeniothrips inconsequens* Uzel)

Although pear thrip is present throughout the State it has been destructive only in parts of the Hudson Valley. Here, in some seasons, the insect causes severe blasting of blossom and leaf buds and a heavy reduction of the crop in a considerable number of orchards. The pear thrips also attack plum, cherry, and apple, but the injury to these fruits is negligible.

The adult thrips are slender, brownish insects about 1/20 inch in length, with long, narrow wings fringed with long hairs. In the spring they emerge from the soil and appear on the trees, usually just as the buds are bursting. They soon work their way into the opening buds and attack the tender flower and leaf parts. If the thrips are numerous, and especially if cool weather retards the further opening of the buds, many blossom clusters are shriveled or blasted and later fall off, while others are stunted and deformed and drop their fruit prematurely. The thrips lay their eggs mainly in the stems of the blossoms and leaves, beginning as soon as the buds open. The young thrips are small, white creatures with red eyes, and hatch in numbers during the blossoming period. They feed in the calyx cups of the blossoms and on the foliage, thus adding to the injury caused by the adults. They become full-grown in two or three weeks, fall to the ground, and enter the soil, sometimes to a considerable depth. In the fall they change to pupae. The pupae pass the winter in tiny cells in the ground.

Control

The only known method of control for the pear thrips consists of spraying with 1 pint of nicotine sulfate in 100 gallons of either a miscible oil diluted at manufacturers' recommendations, or a 3-per-cent lubricating-oil emulsion. This spray will kill the adult thrips while they are clustered on the opening buds. The time for effective spraying is short, and the

grower should watch his orchard carefully and should spray as soon as the thrips are found to be numerous on the buds and the branches. If thrips continue to appear, a second application a few days later may be desirable. In seasons when large numbers of the thrips swarm on the buds before they are expanded enough for them to enter, they can be successfully controlled. When, however, they emerge a few at a time and the buds are open enough for them to enter, satisfactory control is impossible.

A good spray containing nicotine, if thoroughly applied shortly after the petals have fallen, will kill a large proportion of the young larvae, or "white thrips," and will greatly reduce the infestation for the following year. This application corresponds to the regular first psylla-nymph spray and contains the same materials. (See page 9.)

Blister-mite

(*Eriophyes piri* Pagenstecher)

The leaves of pear and of apple are often disfigured by small, reddish or greenish yellow blisters, which later turn brown. Badly infested leaves turn yellowish and fall prematurely. The adult blister-mites pass the winter in the buds beneath the second and third scales. With the bursting of the buds in the spring, the mites migrate to the leaves, burrow through the upper surface, and lay eggs. The young mites feed on the tender tissue inside the leaf, and cause the formation of swellings or blisters. When mature, the mites escape from the blisters through minute holes in the underside of the leaf. They then migrate to fresh leaves and start new blisters. Breeding is continued throughout the summer.

Control

This pest is seldom serious enough to warrant special control measures. It is readily controlled by lime-sulfur, 1–15, or by miscible- or lubricating-oil sprays applied in the fall after the wood has hardened or in the spring before the buds break.

PEAR DISEASES AND THEIR CONTROL

Fire blight

M. F. Barrus

Any careful survey of the pear industry in New York State reveals that two enemies of the pear are more responsible for the failure of the industry to develop than are any others. These enemies are fire blight and psylla. Of these two, fire blight is the more dreaded because its nature and its control are less understood than is the case with psylla. Psylla can be controlled or, at least, held measurably in check by spraying,—a control

measure familiar to every fruit grower. Moreover, while psylla may ruin the crop in certain years, it does not destroy the tree. Blight, on the other hand, cannot be controlled by spraying or by any other familiar control measure, and it may not only destroy the crop in a year when it is prevalent but it may damage the tree severely or kill it. Not infrequently entire orchards are so badly injured by blight as to make any further operation of them unprofitable. Fertilizer and cultural practices that are usually considered desirable for good growth and production make the trees all the more susceptible to blight. This observation has influenced many growers to hold back growth as much as possible, with the result that production has not been all that could be desired.

Fire blight can be controlled without excessive cost by the use of proper methods. This has been demonstrated by the College in orchards where blight had been severe in previous years and where much clean-up work was necessary. A number of alert pear growers of this State have been able to keep the disease well in check by careful attention to the details in the program of blight control. Pear growers, and especially growers of susceptible varieties, can obtain a greater profit from their orchard by adopting such a program of control. Moreover, if this program is carried out faithfully, it will not interfere materially with a desirable development in growth of tree and fruit. Before the pear grower can expect to be successful with these control measures, he must acquaint himself with the known facts about fire blight,— its cause, its appearance on the different parts of the tree at various seasons of the year, the methods of its spread, and the detailed measures to be applied throughout the year.

In addition to pear, fire blight commonly affects apple and quince, and, to some extent, hawthorn. It has been reported as affecting many other plants, including cherry, plum, mountain ash, Van Houttei's spirea, and flowering quince. Most of these plants are so infrequently grown in the vicinity of pears, or the disease occurs so seldom on them, that very little consideration need ordinarily be given them. Since apples are commonly planted adjacent to pears, and occasionally to quinces, and since blight frequently occurs on these plants, it is quite necessary that the grower be able to recognize the disease on them as well as on pears.

Not all varieties of pears are equally susceptible to fire blight. Some of the most popular table and canning varieties, such as Clapp Favorite, Bartlett, and Bosc, are exceedingly susceptible, while Seckel, Anjou, Angoulême, Le Conte, and Kieffer, are reported by some observers to be resistant. None of these varieties are immune, and each may, under some conditions, become badly affected. The Seckel appears to be as resistant as any variety grown in this State, but it sometimes becomes blighted. Kieffer is popularly supposed to be so but is, at times, subject to serious

body cankers. Some of the Asiatic species appear to be very resistant. During the dormant season, all varieties are resistant; resistance begins to be effective as soon as growth slackens and woody tissues begin to develop. The trees are most susceptible during the period when the tissues are succulent and when new tissues are being formed. This period occurs during late spring and early summer but may reoccur during late summer and autumn if rains are abundant and the temperature is favorable for growth. Any soil applications that favor rapid development tend to make the trees especially susceptible, while cultural practices that retard growth tend to shorten the susceptible period.

Fire blight is not destructive to the same degree every year. During some years or series of years, it may do very little damage; during other years or series of years, it may be very prevalent and destructive. It may not be equally destructive in all pear-growing districts of the State during any given year. These conditions are due to environmental factors. If, during a season or a series of seasons, the weather conditions are favorable for rapid growth, if the bacteria causing the disease are relatively abundant and widespread, owing to favorable conditions for their wintering over, and if rains are abundant to promote the bacterial exudation from affected parts just prior to the appearance of the blossom or the insects responsible for transmitting these bacteria are present, the disease is likely to be very prevalent in the region where these conditions obtain. But should any one of these factors be lacking, the disease will diminish.

Symptoms

The manifestations of a disease are known as *symptoms*. There are several symptoms exhibited by fire blight during the course of the season. These are described briefly in the following paragraphs.

During the growing season

One can ordinarily detect fire blight easily during the growing season by the presence of affected shoots, twigs, and blossom spurs, the blackened dead leaves of which contrast sharply with the glossy green healthy ones.

Blossom blight. The first evidence of new infections to appear in the spring is blossom blight. This may usually be observed soon after the petals have fallen. The tender tissues of flower and young fruit suddenly wilt, shrivel, and turn black. The leaves of the flower cluster die and turn black but remain attached. The disease progresses down the spur to the twig, where it spreads out to form a canker about the base of the twig; it may even extend down the twig to the limb and the body of the tree. Apple trees sometimes become so generally affected with blossom and twig blight that the whole tree has the appearance of being scalded.

FIGURE 4. FIRE-BLIGHT CANKER
An active canker showing ooze

Twig blight. Another manifestation of fire blight commonly observed during the summer is twig blight. The growing tips of twigs and water sprouts wilt, bend down, and, on dying, turn brown or black. The dead leaves remain attached to the twig.

Canker. The disease may appear on the limbs, the trunk, or the roots during the growing season as dark water-soaked areas, known as *body blight,* or *canker,* with a margin that is indefinite or is raised or blistered. A milky-colored exudate (figure 4) may ooze from these cankers through the lenticels or through unhealed wounds. These cankers are more difficult to detect at this season of the year than they are during the dormant season when the margins usually are definite and are marked by a crevice (figure 5). When a canker surrounds a limb, the parts above wither and die rather promptly, but this does not occur unless the canker extends inward to the cambium. Fire-blight cankers at the base of a tree are known as *collar blight* and *root blight,* but not all dead areas at this location are necessarily fire blight. When a twig or a water sprout is killed by blight, a canker may be formed about its base on the limb, the trunk, or the root from which it has developed, or these parts may become more extensively affected.

Fruit blight. The fruit is susceptible to infection at any period of its development. Even full-grown fruit sometimes be-

FIGURE 5. FIRE-BLIGHT CANKER
Note the sharp line of demarcation between healthy and diseased tissue

comes diseased. The affected area is at first water-soaked, then turns brown, and finally shrivel. Not uncommonly during the earlier stages of the disease, the milky, viscous ooze issues abundantly from the lenticels of the affected fruit, and drips upon the parts below. This sticky liquid also oozes from the blighted twigs and blossom spurs and from cankers of other affected parts.

Leaf blight. The blackening and dying of leaves on affected twigs and spurs has already been mentioned. In addition, the leaves may become affected independently of the other parts. Water-soaked spots, which later become black, may appear in the blade of the leaf or at the tip and the margin, and occasionally may gradually extend down the petiole to the twig, and cause twig blight.

During the dormant season

The cankers have resulted from infections that occurred during the growing season on roots, trunks, branches, and even twigs. They appear at the dormant season of the year as dark, smooth, more or less sunken area of variable size, usually surrounding the base of a spur, a water sprout, or a small limb that became blighted earlier. Cankers that result from an infection occurring during the spring or the early summer and those checked by drought or other factors, may have a definite margin which is separated from the healthy tissue by a crevice in the bark. Those that result from late summer or fall infections, or extensions from earlier cankers, may have indefinite margins, so it is difficult to tell from the exterior appearance just where the cankers end. By cutting away the outer bark at such points one can readily discover the extent of the canker by the reddish color of the affected tissue. Sometimes a canker completely surrounds a limb, in which case the leaves and the blossoms that are produced the following spring will gradually wither. Some cankers do not extend within as far as the cambium, so that the growth of the cambial layer continues and the canker does little, if any, damage. Usually the bacteria within such cankers die out during the winter or even before. Those cankers in which the bacteria survive the winter are known as *hold-over cankers.* It is important that the grower recognize all cankers, because the first act in the seasonal program consists in removing them from the tree.

The bark of a healthy young pear tree is smooth. After a few years, however, the outer bark cracks and checks, owing to growth within, and becomes rather rough. This early cracking of the bark produces a surface appearance resembling blight canker. The grower need not be confused, however, for, if the inner bark has a bright light green or light yellow color, he may conclude that it is not blight canker. A blight canker usually

has also a dead spur, shoot, or small limb within the cankered area, while the naturally checked areas may or may not have one of these.

Winter injury to the bark may also be confused with blight canker, but such injuries are usually lighter in color and extend farther along the trunk or the branch than do blight cankers. Winter-injured areas in the crotches are especially difficult to distinguish from blight cankers. However, as all such dead areas should be removed, the distinction between them is not important.

Sometimes a blight canker appears so nearly like healthy bark that it is overlooked even by experienced observers. If it is a hold-over canker, viscous milky drops may ooze from cracks and lenticels during the spring and the summer. As these drops dry they become amber or brownish in color. When a grower sees this ooze in a canker, he may know that it is a blight canker even when other symptoms fail. As is pointed out later, such cankers are dangerous and should be detected and removed as early as possible.

Other indications of blight

If one goes, during the dormant season, into a pear orchard that is badly affected with fire blight, he will find many types of symptoms. There will be cankers of varying sizes and appearances, there will be twigs and branches that are dead for varying distances from the top downward, there may be whole trees that are dead, and there may be others that appear unaffected but which actually have such serious cankers at the base of the trunk or on the roots that the tree will die the following year. The leaves of twigs killed by fire blight remain attached all winter and are dry and brown. These brown "flags" in the trees clearly indicate the presence of fire blight. In time they become tattered by the wind, and some are blown away. The leaves of trees whose trunk or roots are girdled by fire-blight cankers may wilt and shrivel as when the tree is girdled with a knife or, if the cambium is not killed until fall, the leaf and fruit buds that develop the following spring will gradually wither and die.

Cause

Fire blight is due to the activity within the plant of a parasitic bacterium known as *Bacillus amylovorus*. That this organism can produce the symptoms already described has been proved time and again. The grower, if he is to be successful in combating fire blight, must understand how and where this organism passes the winter, how it succeeds in getting into the various parts that later become affected, and how it can be destroyed. If he can succeed in keeping this bacterium out of his trees, he can control fire blight.

The bacteria pass the winter in an inactive condition in the tissues at the margin of affected parts of the tree; they are never long alive in the dead parts. They may overwinter in twigs as well as at the margin of cankers on the limbs, the trunk, and the roots. Although the bacteria usually overwinter in pear trees, they frequently overwinter in apple trees. They do not succeed in wintering over in all cankers, and it is usually impossible for the grower to tell which are hold-over cankers. In some cankers the bacteria die before the approach of winter because of the success of the tree in excluding them from living tissues by the formation of a cork layer. Of those entrenched, at the beginning of the winter, in pockets at the margins of the affected areas, some or many may perish before spring. The severity of the winter undoubtedly affects the proportion of hold-over cankers that survive.

During the spring, the bacteria become active and spread into adjoining healthy tissues. They increase rapidly in number and are forced by the millions to the outside of the bark through the lenticels in the form of the milky-colored sticky ooze previously described. This exudate may run down the side of the tree. Later it becomes amber colored and hardens. While it is still sticky, it may be transferred to blossoms and other susceptible parts of the tree. This transmission may be made through the agency of insects which visit the exudate and later the blossoms and other parts, and also by means of water dripping from the exudate in the tops of the trees to the parts below during rains. Once the bacteria are introduced into the blossoms they find suitable food for rapid increase in numbers. These proceed into the flower and thence down the pedicel into the spur, killing the tender cells of these parts. Within a few days to two weeks the blossom spur will be showing the usual symptoms of blossom blight. From the spur the bacteria may proceed to the twig and down the twig to the limb. On apples, particularly the more resistant varieties, a canker is usually formed on the twig around the base of the spur, but the disease does not extend farther. Before the twig becomes affected, the bacteria may ooze out of the blighted spur and blossoms. If the fruit is only partially affected, the bacteria may advance up another pedicel into a young developing fruit and may produce one type of fruit blight.

Ordinarily they will be relatively few blossoms affected with blight as a result of the transfer of bacteria from hold-over cankers, but there may be a general infection in the orchard as a result of the transfer of bacteria from these first blighted blossoms to other flowers in the orchard. Bees and other insects visiting these first-affected blossoms become contaminated with the bacteria, which have rapidly increased in number in the nectar so favorable for their development. They carry these bacteria to blossom after blossom visited lated by them. Considerable evidence has been obtained indicating that bees are not the only agents of dissemina-

tion. *Secondary* infection of the blossoms as well as of the leaves may result from bacteria being washed by rain from the ooze on blossom spurs and twigs onto these parts below. Some observations indicate that blossom blight is more abundant after prolonged rainstorms during the blossoming period than when such storms do not occur at that time. In whichever way blossom infections occur, their subsequent development is similar,— the blossoms are killed, the twig blights, and the infection may spread into the larger limbs and body of the tree.

After the petals have fallen, the danger of infection through the flowers has largely passed. The leaves, the fruit, and the twigs, however, are subject to blight infection at any time during the growing season while they are tender and succulent if "inoculum," that is, bacteria in sufficient quantities is present in the orchard. Hold-over cankers and blossom blight serve as sources of inoculum. Wounds made in the limbs by pruning, by ladders, or by shoes of persons climbing in the trees, and wounds made on the trunk and roots by cultural implements, offer openings through which bacteria may enter. Aphids, leaf hoppers, psylla, tarnished plant-bug, and perhaps other sucking insects, feeding on the blighting parts may carry the bacteria as these insects move to young healthy succulent tissues of twigs and fruit. It is also believed that rain may wash the bacteria into wounds made in leaves, twigs, and fruit by insects and in other ways. Bacteria are able occasionally to enter the leaves, probably through the stomates, and then, by rapid development, travel down the veins and the leaf petiole to the tender shoots.

Once the disease gets under way in an orchard, it is usually at its height during June and July. Meanwhile, water sprouts have shot up into rapidly growing succulent shoots from latent buds of limbs, body, crown, and root, and to these the sucking insects migrate from the blighting twigs and fruits. The bacteria spread rapidly downward through these juicy tissues, often to their base where they form cankers on the larger parts of the tree from which they spring. Usually this development is accompanied by the oozing of the bacteria to the outside of the bark, and these drops of ooze serve as inoculum for the further dissemination of the blight organism. Some of this blight may serve as hold-over cankers in which the bacteria live throughout the winter.

A tree is in a susceptible condition only when its tissues are in a tender growing condition. After wood begins to form, susceptibility decreases. Some varieties remain in this susceptible state for a longer period than others and, consequently, are more likely to be blighted. Trees that are grown under conditions that promote a long period of growth remain in a susceptible state for a longer time than do trees grown under conditions unfavorable for sustained growth. A long period of warm rainy weather in early summer, or even later, renders the trees

susceptible during or following that period. Heavy applications of manure also bring about a longer period of susceptibility than do the early applications of quickly available nitrates. Continued cultivation of the orchard during spring and early summer also tends to promote growth and to render the tree susceptible. Trees grown under conditions unfavorable for rapid and continued growth, such as poor soil, applications of fertilizer deficient in nitrogen, and sod culture or lack of cultivation, are not likely to become blighted or, if affected, they do not blight badly. It should also be said that trees given such conditions usually do not produce profitable crops.

It must be clearly understood that being in a state of susceptibility does not mean that the tree will necessarily become blighted. The bacteria causing blight must first be introduced into the susceptible part before blight can develop. If there are no blight bacteria available in the orchard or near-by, the trees may remain in a susceptible condition all summer without blighting. In order for blight to spread from tree to tree in an orchard, there must be some agency to carry the bacteria from the place where they occur to the susceptible parts of the tree. If these agencies are absent, although the trees may be in a susceptible state and the bacteria may be present in the orchard, blight will not spread except in those trees in which the bacteria have succeeded in passing the winter. The first spread from hold-over cankers is usually to the blossoms of the same or near-by trees. Before such a transfer can take place, the bacteria must have oozed from the hold-over cankers just previous to or during the blossoming period. Oozing usually takes place most actively following abundant rains and during warm humid weather. Should no blossom infection occur in an orchard, twig blight and water-sprout blight are not so likely to be troublesome, although such infections may take place.

It must be evident that an epidemic of fire blight, especially in its earlier stages, is dependent upon a number of factors operating more or less simultaneously. The very fact that epidemics do occur indicates that such factors do thus become operative. Control consists in preventing the effective operation of one or more of these factors.

Control

In order to be successful in controlling fire blight, it is necessary for a grower to undertake the complete program of control measures outlined in the following paragraphs. If the grower follows only a part of the program, he may be fairly successful in years when blight is not especially troublesome and when the spread is slow, but sooner or later he will find that it has become well established and that he has lost in trees more than he has saved in control practice.

Consider what is necessary to be done in an orchard in which the disease has become well established. A good time to start the control program

is during the dormant season because at that time there is little danger of spreading the bacteria from tree to tree on pruning tools.

Each tree in the orchard should be examined carefully to determine which ones should be removed. Those that are dead and those so badly blighted that it is impractical to save them should certainly be removed. Trees with dead tops, due to body cankers surrounding the trunk or to extensive root or crown cankers, should be pulled out. Trees with the tops still alive but with extensive cankers girdling body or crown should ordinarily be removed. Trees having large cankers on the scaffold limbs or at the crotches may sometimes be saved. If, however, such limbs are girdled by the cankers or if the crotch cankers are extensive, it is usually impractical to save the tree. Since it is sometimes difficult to detect or to remove all of the affected portions of extensive cankers, the tree constitutes a danger to the other trees, for the bacterial ooze likely to come from the cankers the following spring may serve as a source of inoculum from which infective material can be carried.

The next step is to remove the dead and diseased parts of blighted trees that can be saved. All limbs, large and small, blighted from the top down should be removed at a point at least from 6 to 8 inches below the margin of the dead and healthy areas if there is a definite crevice separating these parts. If there is no definite crevice, the margin of the diseased area must be determined by cutting away the outer bark at the apparent margin so that the actual extent of the diseased area can be determined by the color. Diseased tissue will have a brownish or reddish color, while the healthy tissue will be light green or light yellow. In such cases the cut should be made at a point 12 inches or more below the lowest margin of the diseased area. In any case, it is advisable in removing a limb to cut it at its junction with another limb in order to induce a callus formation over the wound. All blighted twigs should be removed also. In removing these, one should cut well below the dead area.

The next procedure is to remove the cankered areas from the larger limbs, the trunk, and the roots. This requires a little more judgment and patience than removing dead limbs, but is not especially difficult. If the grower can detect the hold-over cankers, he needs to remove only those, as far as control of blight is concerned, but it is very difficult to distinguish them from the other cankers.

Usually the cankers can be distinguished from the natural crackinng of the bark of a healthy trees by their more sunken condition and by the presence within the area of a dead spur, a water sprout, or a limb. Blight cankers are usually somewhat darker in color than is the surrounding healthy bark, and the inner bark of the canker is usually dead and is brown in color.

One should make a cut, with a sharp, heavy-bladed knife, or a farrier's knife, through the bark to the wood, and completely around the canker. All the bark within this cut should be removed. The cut may be made fairly close to the sides of the canker — an inch or more away — but should be from 3 to 6 inches from the margin at the top and the bottom. Usually the area removed should be oval in shape, but this will depend somewhat on the shape of the canker itself. In any case it should be pointed at the top and the bottom. The cut should be made at right angles to the surface and not slanting. If the canker has no definite crevice separating the healthy and dead areas, the margin must be determined from the color of these parts after shaving away the outer bark. In the latter case, the cut should be made at a greater distance from the margin of the canker, especially at the top and the bottom. If the blight cankers do not extend inward as far as the wood, only the outer dead part need be removed.

A disinfectant need not be applied to wounds made by removing blight during the dormant season, at least until about March 15. During the spring or after the wounds are thoroughly dry, they should be covered with a coating of a good wound dressing[1] in order to prevent the entrance of wood-decaying fungi. When the surface exposed is large, this covering may need to be applied every year or two until the callus covers the wound. Wounds made during the growing season should be disinfected before applying the wound covering.

All blighted parts, especially larger ones, removed from the tree should be taken from the orchard and burned. It is generally supposed that the bacteria die upon the death of the tissue, but during cold moist weather they may live for some time in detached parts left on the ground. It has also been shown that the bacteria may live for some months in the dried ooze.

All fruit spurs and water sprouts should be removed from the body and scaffold limbs, as these offer opportunities for the blight bacteria to enter quickly and do considerable damage before blight is discovered in them. Also, suckers coming from the roots and the crown should be removed for the same reason.

After the treatment of all the trees in the orchard has been completed, a second careful inspection should be made to be as sure as possible that no hold-over cankers have been overlooked. During the period just previous to blooming, a very thorough search should be made again for hold-over cankers. This is a time when oozing may be taking place.

[1] Coal tar obtained from the manufacture of gas makes a suitable wound dressing, but is somewhat variable in consistency. Pure white-lead paint will prevent checking of the wood to some extent, but must be renewed frequently. Asphaltum melted or dissolved in benzine has been recommended. A bordeaux paint is much used in the West.

Success in control depends so largely in preventing or, at least, in reducing the primary infections that no effort should be spared in discovering such oozing cankers before the bacteria can be conveyed to the blossoms. Such cankers should be removed in the manner previously described, and the additional precaution should be taken of applying a disinfectant to all wounds made with tools shortly after the operation. The disinfectant consists of 1 part of mercuric chloride and 1 part of mercuric cyanide to 500 parts of soft water. This can be made by dissolving in 1 gallon of water ¼ ounce of each of the two chemicals. This disinfectant should be used in all summer pruning when removing blighted parts.

Beginning shortly after the blooming period, weekly inspections should be made of all trees in the orchard in an effort to discover and to remove blossom and twig blight before it has had a chance to extend into the limbs. These blighted parts can usually be broken off with greater rapidity and safety than they can be cut, and the wounds thus made need not be disinfected. The entire twig should be broken well below any evidence of blight. If the first blighted blossom spurs can be removed early, much secondary infection can be prevented. Patrolling the orchard twice a week during the first week or two after the blossoming period may be well worth while. The inspections can usually be quickly made. A time of day should be selected when the blight shows up most plainly. The glare of the sun often prevents one from detecting blight readily.

During these inspections, one should keep a lookout for oozing cankers, which, if discovered, should be promptly removed. Should blossom or twig blight be developing, the source of the inoculum must be located and destroyed. It is desirable to break out the scattered late blooms, to prevent infection through them. As water sprouts appear, they should be rubbed off. Suckers springing from the roots and the base of the tree should be removed as they appear.

As the season advances and the wood begins to harden, the danger from new infections decreases. Not infrequently, however, heavy and continued rains during the summer or even in the early autumn may stimulate a renewed activity on the part of the tree and bring it again into a susceptible condition. If blight has been kept under control and all live cankers have been removed, there is relatively little danger of fire blight appearing in such growth.

Should the blight become epidemic during early summer or at any time when the trees are in a susceptible condition, much greater precautions must be taken in eradicating affected parts to avoid spreading the organism than is necessary during the dormant season. In removing twigs and branches, it will be necessary to cut farther down and to make the cuts about the cankers at a greater distance from the apparent margin of the

canker. One must ascertain from the color of the tissue that he has cut back into healthy bark.

If one could, by applying some chemical to the surface, destroy the bacteria within the canker without injuring the living tissues, a long step forward in the control of blight could be made. It would then not be necessary to cut out the canker, and the danger of spreading blight with the tools would be lessened. Some progress in this direction has been made in California by the application of solutions of zinc chloride. Preliminary tests of the use of this material in New York State have caused some injury to the tree at the strength used. Work on this phase of blight control is being continued by the Cornell University Agricultural Experiment Station, where this and other chemicals are being given a thorough trial in order to determine the strength and the method of application that will be effective and safe.

Success in the control of blight can be facilitated by controlling the growth of the tree itself. This does not infer that growth should be checked as much as possible, but it does mean that rapid twig growth should not be permitted to continue for a long time. Manure should be used sparingly, if at all. Nitrogen can be supplied early in the form of quickly available sodium nitrate, which will permit the early growth that is desirable. The orchard may be cultivated if this is needed to obtain the necessary growth, but cultivation should stop when this has been obtained. The orchard should then be seeded to a cover crop. Should blight begin to spread in the orchard, the grower should endeavor to check growth as promptly as possible. He needs only to remember that blight spreads with great rapidity in rapidly growing succulent tissue to appreciate the reason for these precautions.

Some time in the future it may be possible for growers to obtain trees of resistant stocks or even with resistant bodies. In Oregon, resistant varieties have been grafted onto the immune Chinese seedling roots, and these have been top-worked to standard varieties, thus giving trees with roots, trunks, and main branches highly resistant to fire blight. This reduces the danger of blight cankers to these parts, although the tops are susceptible if susceptible varieties are used in top-working. However, such trees have not proved to be very satisfactory. The fruit on trees grown on some of these seedlings in California has been worthless because of black-end, a physiological breakdown at the calyx end. The Japanese pear seedlings are also susceptible to a mushroom root rot when grown on recently cleared land.

It is inadvisable to set a new pear orchard adjacent to an apple orchard of blight-susceptible varieties or to a quince orchard, for an orchard so set increases the hazards due to blight and is bound to increase the expense

of keeping the pears free from this disease. The removal of the bloom from pear trees too young to permit bearing will aid greatly in keeping such trees from blight during these early years.

One might assume from the foregoing paragraphs that the cost of this eradicatory work would be prohibitive, but the actual cost is not so great as it may appear. The removal of dead and dying trees and of the blighted limbs of others should be done anyway. The cost of cutting below the active blight area is no greater than cutting through it. It is simply a matter of doing the work intelligently. The cost of cutting out cankers and of patrolling the orchard, with the necessary work of removing blighted parts during the summer, must be charged to blight control. Records kept by research men at the New York State College of Agriculture of the cost of blight clean-up in two small orchards in central New York during 1929 indicate that it is less than the cost of spraying for psylla control in these orchards. In another orchard containing 3000 trees, the cost of a seasonal program of control amounted to $21 an acre the first year, $12 the second year, and $3 the third year. The difference in cost is due, of course, to a decrease in the amount of blight in the orchard in the succeeding years. Additional cost accounts are needed, for certainly the cost will be somewhat greater during an epidemic year than during a year when new infections seldom take place. But it need not be excessive even then if a thorough clean-up is made during the winter or the early spring.

More labor and greater vigilance will be required in controlling blight in an orchard that adjoins or is near other orchards affected with blight and in which no program of control is in force than in one more isolated. The most successful control will come from a united community effort. Growers in pear-growing communities could well organize for blight control and employ a trained man who would oversee the work of the grower himself or of his assistant and would give the needed advice and assistance throughout the season. Such a man could also advise the spraying practices of the community.

OTHER PEAR DISEASES

W. D. MILLS

Pear scab

Pear scab is very similar in appearance to apple scab and is caused by a closely related fungus called *Venturia pyrina,* but the two diseases are distinct. The pear-scab fungus does not attack apple, nor does the apple-scab fungus attack pear.

The pear-scab fungus commonly affects the fruit and the leaves but

may also be found on the leaf stalks, the flowers, and the twigs. The first appearance of the scab on the leaves is a dull smoky area difficult to see without careful examination. A little later the spots become more olive colored, velvety, and much more noticeable. The spots on the fruits first appear as small circular olive-colored areas, but later, as the fungus spreads and the fruit grows, the familiar scabby spots are produced, sometimes accompanied by a cracking of the fruit.

The appearance on the leaf stalks and the flowers is similar to that on the leaves. The scab spots on twigs vary with the variety but often become somewhat swollen, with a blistered or scurfy appearance.

The pear-scab fungus, like the apple-scab fungus, overwinters as partly developed fruiting bodies (perithecia) in the old fallen scabby leaves. Unlike apple scab under New York conditions, it also overwinters to a considerable extent in affected twigs.

The spring spores (ascospores) of the pear-scab fungus mature in the perithecia somewhat later than do those of apple scab and are readily recognized under the microscope by their greater length. When the ascospores are mature, a few minutes' rain is sufficient to wet the old leaves on the ground and will cause the shooting of the ascospores to a distance of about ¼ inch from the leaves. Air currents then carry the light spores for long distances, and many of them settle on the green parts of the pear trees.

If the green tissue is wet when the spore lodges and if it remains wet for a long enough time, the spore will germinate and send its sprout, or germ tube, into the tissue. Summer spores are also produced on the affected twigs and are washed to leaves and fruit, making an important method of spread which is very rare in the case of apple scab in New York.

In most years pear scab is not important in the commercial pear orchards of the State. This disease is most common on Flemish Beauty, Winter Nelis, and Easter Beurre. None of these very susceptible varieties are widely grown in the State.

Control

In most commercial pear orchards the seasonal spray program followed for pear psylla and other troubles is sufficient for scab control. In locations where scab has been serious in the past, a special application of a fungicide just as the buds are showing green may be advisable.

Pear leaf-blight

Leaf-blight occurs commonly on pears in practically all nursery districts. In New York it is said to be more abundant in the pear orchards of the Hudson Valley than elsewhere. The disease causes its greatest

damage on pear seedlings in the nurseries, but occasionally severe injury to leaves and fruit of bearing orchards occurs.

The leaf-blight fungus, *Fabraea maculata,* causes a spotting of the pear leaves very similar to that produced on quince by the same fungus. At first the spots are circular and discolored, with reddish centers and dull borders; later they extend through the leaf and show on the underside. The spots on the leaves differ from the spots of the Mycosphaerella leaf-spot by being smaller, more circular, and darker-colored. There is one raised black dot in the center of the leaf-blight spot, in contrast to the numerous small black bodies in the Mycosphaerella leaf-spot. The spots on the fruit are at first red but become dark colored later. The skin is roughened, and cracking of the fruit may follow.

The fungus causing this trouble overwinters in the dead leaves in much the same way as does the apple-scab fungus. The fruiting bodies in these fallen leaves are usually ripe and ready to shoot out their ascospores by the blossoming time of the pear. The ascospores are discharged during wet weather and are carried by the air currents up into the trees.

The spores that lodge on tender leaf tissue germinate and grow into the leaf, and about a week later the spots begin to appear. Later the summer sports are borne in the black fruiting bodies already mentioned, which are in the center of each spot. These spores are spread, and start new infections during wet periods. The spots rarely appear on the pear fruit.

Control

The disease may be controlled with lime-sulfur or bordeaux mixture. Unfortunately, lime-sulfur, even at a dilution of 1–50, is extremely unsafe on pear trees after the blossoming period. Bordeaux mixture 3–8–50 will control the disease but is also likely to cause russeting of the fruit. Experiments have not been run to determine the control obtained by the weak bordeaux spray recommended for pears in the spray schedule containing but 2 pounds of copper sulfate in 100 gallons of the spray mixture. (See page 9.) Unless the leaf-blight has been serious in the orchard, it would seem safest to use this weak copper-lime spray on bearing trees. On seedings in nurseries, the stronger bordeaux mixture may be used safely. Sulfur dust, copper-lime dust, and dry-mix sulfur-lime spray have not been tested, but from the results obtained on the disease in quinces it would seem probable that the sulfur dust and the dry-mix sulfur-lime spray might give commercial control, while the copper-lime dust cannot be relied upon.

Mycosphaerella leaf-spot

Mycosphaerella leaf-spot is usually called *Septoria leaf spot* or simply *spear leaf-spot,* and is caused by the fungus *mycosphaerella sentina.*

When heavy leaf infections occur, defoliation may take place by August or earlier. This results in checking the ripening of buds and shoots, and causes the tree to be susceptible to winter injury. This leaf-spot is recognized by the dark, angular spots with light gray centers, which contain the very dark, pin-point-like, fruiting bodies of the fungus. The fungus overwinters in the fallen leaves, from which its spores are shot in the spring during rain periods.

Control

This disease is of little importance in well-sprayed pear orchards. Frequent inquiries regarding this trouble are received from owners of unsprayed pear trees.

THE PEAR SITUATION IN NEW YORK

T. E. LAMONT[2]

Acreage and production of pears on western New York fruit farms

In 1928 the average acreage of bearing pear trees was less than 2 acres per farm in the Newfane-Olcott, Hilton, and Morton areas, where farm-management surveys were taken (table 1). In these areas, the average acreage of bearing apple trees was from six to ten times that of pear trees.

TABLE 1. AVERAGE ACREAGE OF APPLE, PEACH, AND PEAR TREES PER FARM IN NEWFANE-OLCOTT, HILTON, AND MORTON AREAS, 1928*

Kind of trees	Area		
	Newfane–Olcott	Hilton	Morton
Bearing trees:			
Apples	11.4	13.2	18.1
Peaches	3.7	0.6	6.8
Pears	1.8	1.7	1.7
Non-bearing trees:			
Apples	2.2	1.7	3.8
Peaches	1.5	0.5	0.9
Pears	0.1	†	†

* The acreage of pear and peach trees was calculated for each farm by dividing the total number of trees living in 1928 by the number of places per acre. The acreage of apple trees is the area actually covered by the orchard.
† Less than 0.01 of an acre.

In the Newfane-Olcott and Morton areas the acreage of bearing peach trees per farm was more than twice that of pear trees. The lighter well-drained soils in these two areas are well adapted to peaches.

Pears accounted for only 3.2 per cent of the total receipts on the

[2] AUTHOR'S ACKNOWLEDGMENTS. The author is greatly indebted to the farmers in the Newfane-Olcott, Hilton, and Morton areas for furnishing the data on pear acreage, yields, and prices; to Professor G. P. Scoville of the New York State College of Agriculture for the use of the Newfane-Olcott data for 1913 to 1926; to Professor S. W. Shear of the University of California for use of data from *Economic Aspects of the Pear Industry*, Bulletin 452 of the University of California Agricultural Experiment Station, and from *Pacific Coast Pear Supply and Price Situation*, a mimeographed report issued in 1929.

Newfane-Olcott farms from 1913 to 1928, while apples and peaches made up 54 per cent.

Nearly all of the pear trees in these areas were of bearing age in 1928. Most of the farms, however, had only a small acreage of pear trees. Out of the 307 farms surveyed, only 6 had more than 10 acres of pears and only 13 had between 6 and 10 acres (table 2). Seventy-three per cent of the farms had 2 acres or less of pears in 1928.

TABLE 2. DISTRIBUTION OF FARMS ACCORDING TO ACREAGE OF BEARING PEAR TREES, NEWFANE-OLCOTT, HILTON, AND MORTON AREAS, 1928

Acres	Newfane	Hilton	Morton	Total	Newfane	Hilton	Morton	Average
	Number of farms				Per cent of farms			
None	40	33	13	86	23	30	47	28
0.01 to 2.	87	45	6	138	51	41	21	45
2.01 to 4.	27	14	2	43	16	13	7	14
4.01 to 6.	5	10	6	21	3	9	21	7
6.01 to 8.	5	2	0	7	3	2	0	2
8.01 to 10.	3	2	1	6	2	2	4	2
10.01 to 12.	0	1	0	1	0	1	0	0
12.01 to 14.	3	2	0	5	2	2	0	2
Total	170	109	28	307	100	100	100	100

The total acreage of bearing pear trees has remained about the same on the Newfane-Olcott farms from 1913 to 1928, but there has been a marked decrease in the acreage of trees of non-bearing age (table 3). At the beginning of the period about one-third to one-fourth of the acreage was of non-bearing trees. Since 1922, the acreage of trees of non-bearing age has been less than 0.1 acre per farm. The decline in 1928 is due

TABLE 3. PEAR ACREAGE, PRODUCTION, AND SALES, NEWFANE-OLCOTT FARMS, NIAGARA COUNTY, NEW YORK, 1913 TO 1928*

Year	Number of farms	Pear acreage per farm		Bushels per acre	Price per bushel	Pear sales per farm
		Bearing age	Non-bearing age			
1913	89	1.3	0.97	116	$0.82	$128
1914	98	1.4	0.43	65	0.86	80
1915	81	1.6	0.62	41	0.98	65
1916	87	1.2	0.42	44	1.02	55
1917	113	1.5	0.52	32	1.40	68
1918	159	1.6	0.44	41	1.58	105
1919	156	1.9	0.29	23	2.38	102
1920	178	1.9	0.28	68	1.25	132
1921	171	1.8	0.26	22	1.85	77
1922	178	2.1	0.13	105	0.85	186
1923	194	1.9	0.04	36	1.74	124
1924	202	1.9	0.08	46	1.39	122
1925	172	2.2	0.06	96	1.35	292
1926	187	2.1	0.04	70	1.27	187
1927	170	2.1	0.04	23	1.25	52
1928	149	1.8	0.07	23	1.18	49
Average	..	1.8	0.29	53	$1.32	$114

* Data for 1913 to 1926 are taken from the files of G. P. Scoville.

to the fact that some trees were killed in many of the orchards, and in some entire blocks were pulled out during the winter of 1927–28. Declines since 1928 are not shown in table 3. Some pear orchards were pulled out during the winters of 1928–29 and 1929–30.

The number of Bartlett and Kieffer pear trees set during each five-year period for trees living in 1928 are shown in figure 6. These two varieties made up about 91 per cent of all the pear trees in the Newfane-Olcott and Hilton areas. In the Newfane-Olcott area, 63 per cent of all the pear trees were Bartlett and 28 per cent were Kieffer. In the Hilton

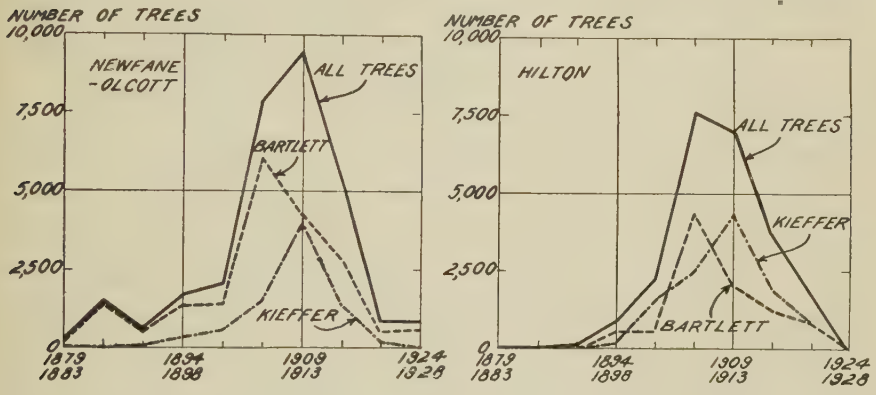

FIGURE 6. NUMBER OF PEAR TREES THAT WERE LIVING IN 1928 THAT WERE SET DURING EACH FIVE-YEAR PERIOD FROM 1879 TO 1928, 149 FARMS IN THE NEWFANE AREA AND 109 FARMS IN THE HILTON AREA

In both areas, the periods of heaviest planting were from 1904 to 1913. Relatively few pear trees have been planted since 1919

area, 42 per cent were Bartlett and 50 per cent were Kieffer. The period of heaviest setting was from 1904 to 1913. Relatively few pear trees have been set since 1919. This has been due to the unprofitableness of pears under most conditions in western New York.

Yields of pears

Yields on Dunkirk and Clyde soils, Newfane-Olcott area, 1913 to 1928

One of the most important factors affecting yield of fruit trees is soil. Most of the soils about Newfane and Olcott belong to the Dunkirk and Clyde series.[3] The Dunkirk soils are light in color. The Clyde soils have been subject during their development to poor drainage conditions, and the organic matter accumulated during that period gives them a dark color. They are still poorly drained compared with the well-drained Dunkirk soils.

[3] Soil survey of Niagara County, New York. By Elmer O. Fippin and others. *In* Report of the field operation of the Bureau of Soils. U. S. Agr. Dept. Rept. 1906:69–117. 1908.

The Dunkirk sandy loam soil yielded 17 bushels more pears per acre than did the Clyde fine sandy loam (table 4). The Dunkirk soil yielded 30 bushels more apples and 59 bushels more peaches per acre than did the Clyde soil. These differences would be even greater except that many of the farms classified as on Clyde soil have patches of Dunkirk soil. Orchards are generally set on the best soil on the farm.

TABLE 4. YIELDS OF PEARS, APPLES, AND PEACHES ON DUNKIRK SANDY LOAM AND CLYDE FINE SANDY LOAM SOILS, NEWFANE-OLCOTT AREA, NIAGARA COUNTY, 1913 TO 1928*

Crop	Clyde fine sandy loam soil	Dunkirk sandy loam soil	Increase in yields on Dunkirk sandy loam over those on Clyde fine sandy loam	
	Bushels per acre		Bushels	Per cent
Pears	39	56	17	44
Apples	100	130	30	30
Peaches	49	108	59	120

* Data for 1913 to 1926 are taken from the files of G. P. Scoville.

At the present relative low prices of such intensive crops as pears, apples, and peaches, these crops are not profitable on the Clyde soils. Today, labor is the major item in the cost of producing fruit. Its cost is very high. The cash wages paid year men in the Newfane-Olcott area in 1928 were nearly double the wages paid in 1913. The yields on the Clyde soils are too low to pay these high costs.

An orchard is a long-time investment, and the labor costs are so high relative to land costs that it is a serious mistake to set orchards on anything but the best fruit soils. Apparently, a well-drained soil is most important for peaches, but it is as important for pears as for apples. However, the pear problem in New York is generally not a question of setting new planting, but of maintaining old ones. In many cases the pear yields are so low on the poor fruit soils that the orchards are not worth maintaining. Growers under such conditions would be better off to use such poor fruit land for less-intensive crops.

Even on good soils inefficient production as a result of small orchards often make such plantings unprofitable. When labor is high, it is very important to have large orchards on good fruit soil.

Average yields of pears by growers, Newfane-Olcott area

The average yield over a period of years for growers who had more than 2½ acres of bearing pear trees is shown in table 5. The average yield of these 40 growers was 56 bushels per acre. Seventy per cent of the growers had yields below 70 bushels per acre. These yields may be too low, because in some years Kieffers were not worth harvesting.

Low pear yields are probably the primary reason for the unprofitableness of pears in western New York. Low yields are often due to lack of vigor. On poor fruit soils it is difficult to obtain vigorous growth, and on good fruit soils growers are afraid of blight if vigor is increased. Pear psylla has often reduced the vitality of the trees. In some cases adequate cross-pollination has not been provided.

One grower averaged 163 bushels per acre from 1917 to 1928. This was the only grower to average more than 103 bushels per acre. This grower had about 2 acres of Bartletts set in 1887 and 3 acres set in 1904. Adjacent to the Bartletts was a 2-acre block of Kieffers set in 1911, but these were cut out in 1928. The orchard is located on well-drained Dunkirk loam and Dunkirk gravelly sandy loam soils. The vigor of the orchard has been maintained by the yearly application of nitrate of soda and manure. He has obtained fairly good control of pear psylla. About 20 trees of Sheldon, Anjou, and Clapp Favorite are scattered through the Bartlett block. Pollination has been facilitated also by the keeping of bees on the farm.

This grower received a gross return per acre of $229 for pears and $218 for apples. He averaged 59 barrels of apples per acre from 20 acres set in 1885 and 12 acres set in 1904.

TABLE 5. DISTRIBUTION OF FARMS ACCORDING TO AVERAGE YIELD OF BEARING PEAR TREES, NEWFANE-OLCOTT AREA, 1913 TO 1928*

Bushels of pears per acre †	Number of farms	Per cent of farms
Less than 30	7	18
30 to 49	10	25
50 to 69	11	27
70 to 89	9	22
90 to 109	2	5
110 to 163	1	3
Total	40	100

* Data for 1913 to 1926 are taken from the files of G. P. Scoville.

† The average yield of a grower is for the years that his record was taken. No farm was included on which a record had not been taken for seven or more years out of the sixteen years from 1913 to 1928 and on which there was less than 2.5 acres of bearing pear trees.

Yields in the Rogue River Valley, Oregon

Pear yields in the Rogue River Valley, Oregon, for 1924, 1925, and 1927 were 140 boxes, or more than two and one-half times the average yield in the Newfane-Olcott area (table 6). Growers in the Rogue River Valley spend more time cultivating, pruning, trimming out blight, and doing other cultural operations than do growers in western New York, and the value of their land is much higher than that in western New York. However, the returns from pears in the Rogue River Valley in recent years have been sufficient to stimulate new planting in that area.

TABLE 6. AVERAGE YIELD OF PEARS IN THE ROGUE RIVER VALLEY, OREGON, 1924, 1925, AND 1927*

Year	Boxes per acre
1924	110
1925	130
1927	180
Average	140

* From *Cost and Efficiency in Pear Production in the Rogue River Valley,* by Ralph S. Besse, W. S. Brown, and L. P. Wilcox. Oregon State Agr. Coll. Agr. Exp. Sta. Bul. 267:48. 1930. No cost records were taken for 1926 because of the unusual situation occasioned by the spray-residue difficulty. The year 1926 was one of heavy pear production for the State of Oregon. When 1924 = 100, the index number of Oregon pear production was 122 in 1925, 171 in 1926, and 155 in 1927. The index number of yield in the Rogue River Valley when 1924 = 100 was 118 for 1925 and 164 for 1927.

Returns per acre for pears and apples, Newfane-Olcott area, 1913 to 1928

The returns per acre for apples was more than twice that for pears in the Newfane-Olcott area from 1913 to 1928 (table 7). This is the primary reason why the acreage of apples increased 33 per cent in the Newfane-Olcott area from 1913 to 1928, while the acreage of pears remained nearly the same. To make the gross returns per acre from pears equal to the return from apples, the yield of pears would have to be nearly doubled. The higher returns from apples have caused growers desiring to plant new orchards to set apples instead of pears. Unless one can obtain more than three-fourths as many bushels of pears to the acre as of apples, it probably is advisable to plant apples instead of pears.

TABLE 7. RETURNS PER ACRE FOR PEARS AND APPLES, NEWFANE-OLCOTT AREA, 1913 TO 1928*

Year	Pears	Apples	Increase of apples over pears
1913	$ 95	$180	$ 85
1914	56	132	76
1915	40	99	59
1916	45	93	48
1917	45	39	—6
1918	65	218	153
1919	55	174	119
1920	85	194	109
1921	41	132	91
1922	89	153	64
1923	63	109	46
1924	64	131	67
1925	130	152	22
1926	89	116	27
1927	29	70	41
1928	27	91	64
Average	$64	$130	$66

* Data from 1913 to 1926 are taken from the files of G. P. Scoville.

Prices of pears

Purchasing power of pears and apples, Newfane-Olcott area, 1913 to 1928

From 1913 to 1928, the general trends in the purchasing power of the farm price of pears and apples in the Newfane-Olcott area have been similar (figure 7). This indicates that price trends have been the reason why growers have set apples instead of pears.

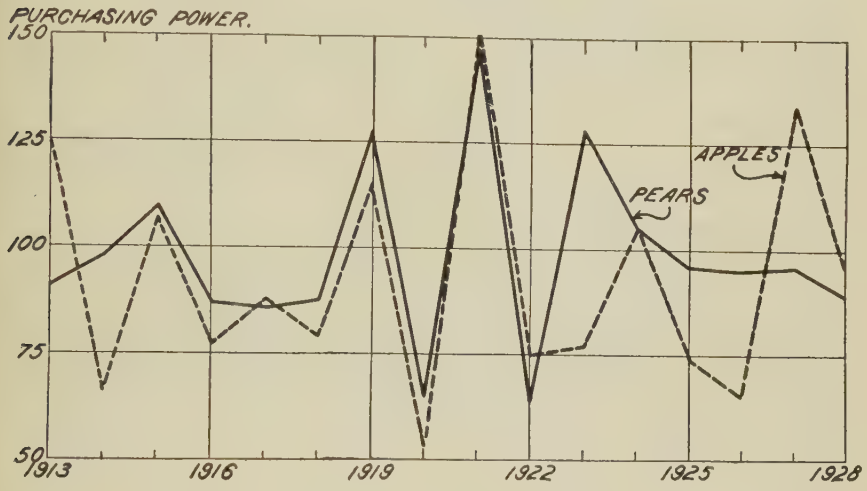

FIGURE 7. PURCHASING POWER OF THE FARM PRICE OF PEARS AND APPLES, NEWFANE-OLCOTT AREA, 1913 TO 1928

(1913–15 = 100)

For 1913–1928, the general trend in the purchasing power of pears and apples has been similar

Purchasing power of Bartlett pears and Baldwin apples, New York City, 1879 to 1929

The trend in purchasing power of the New York wholesale price of Bartlett pears and Baldwin apples is shown in figure 8. The purchasing power of Bartletts was extremely high during the eighties but declined sharply during the nineties. The purchasing power of Baldwins increased until the nineties and then declined.

When 1910–14 is used as a base, the trend in purchasing power of Bartletts in bushels and in barrels was about the same from 1915 to 1921. Since 1921, the purchasing power of Bartletts in bushels has been higher than that for Bartletts in barrels. For this reason the ten-year averages of the purchasing power of Bartletts in bushels since 1910–1919 are shown in figure 8. Since 1911–1920, the ten-year average trend in the purchasing power of Bartletts in bushels and of Baldwins has been slightly upward.

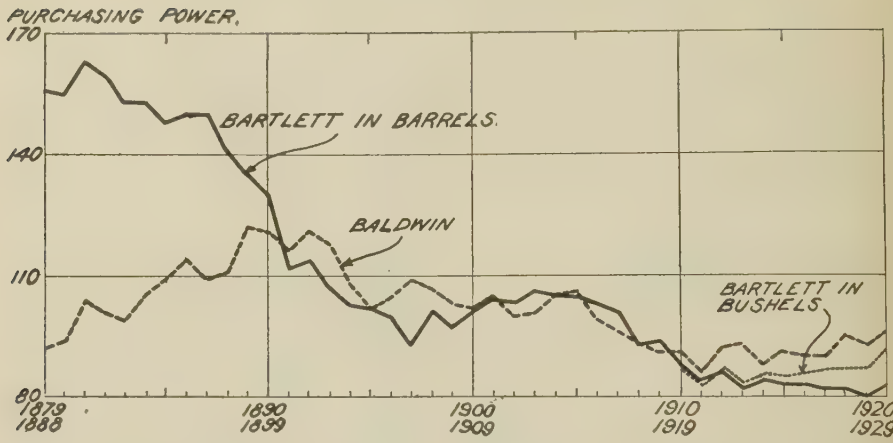

FIGURE 8. PURCHASING POWER OF BARTLETT PEARS AND BALDWIN APPLES IN NEW YORK CITY, TEN-YEAR MOVING AVERAGES FROM 1879–1888 TO 1920–1929

(1910–14 = 100)

The trend in purchasing power of Bartlett pears in barrels has shown a consistent decline except for a brief period about 1905 to 1910. Since 1911 to 1920, the purchasing power of Bartlett pears in bushels and of Baldwin apples has increased slightly.

Original data on prices earlier than 1910 were taken from a thesis by G. W. Peck, *The Prices of Apples and Pears on the New York City Market from 1853 to 1917*, Cornell University, 1918. (Unpublished.) Prices from 1910–1926 were taken from the files of G. P. Scoville. Quotations were taken from the Saturday issue of the *Producers' Price Current*. The high and low quotations for each Saturday were averaged by months

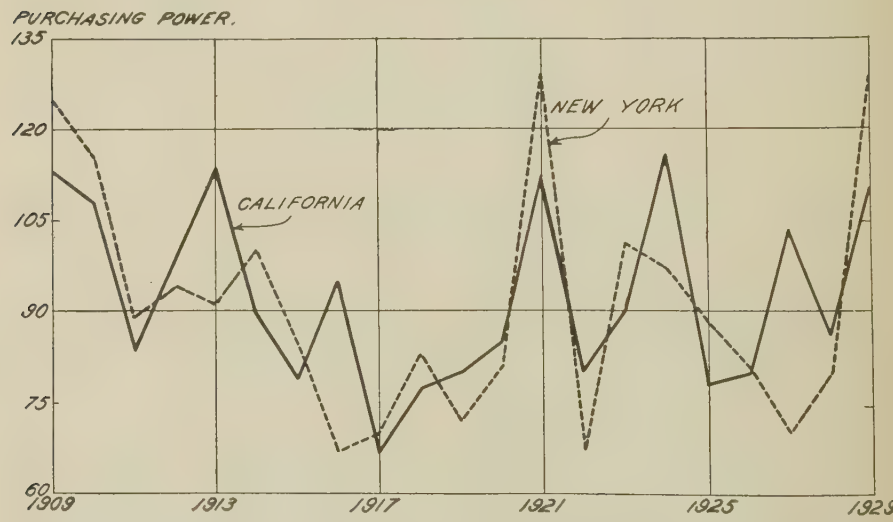

FIGURE 9. PURCHASING POWER OF NEW YORK BARTLETT PEARS IN BUSHELS AND OF CALIFORNIA BARTLETTS IN BOXES, NEW YORK CITY, 1909 TO 1929

The purchasing power of New York and California Bartletts has shown about the same general trend over the period 1909 to 1929.

The price of California Bartletts is the gross auction price per box taken from *Economic Aspects of the Pear Industry*, by S. W. Shear, College of Agriculture, University of California, Bulletin 452, table 6, 1928. Prices for 1928 and 1929 were furnished by Dr. Shear.

Purchasing power of New York and California Bartlett pears, New York City, 1909 to 1929

The relationship between the purchasing power of New York and California Bartlett pears on the New York market is shown in figure 9. In 1927, the quality of the New York Bartletts was generally poor. Most of the stock was affected to some extent by psylla.[4] The poor quality probably accounted for the low price of New York Bartletts in 1927, because the New York and Northwest crops were short during that year. The general trend in the purchasing power of New York and California Bartletts has been similar. Changes in wholesale prices since 1909 do not account for the increased production in California and the decreased production in New York.

Farm price of pears in New York and Oregon, 1913 to 1929

The farm prices of New York and Oregon pears are shown in figure 10. The New York farm price has increased more than has the Oregon price, and during the past four years has averaged 35 cents per bushel above

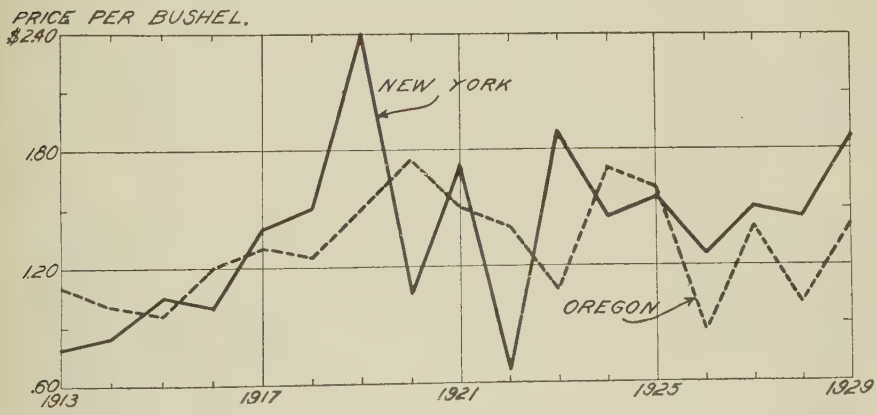

FIGURE 10. NEW YORK AND OREGON FARM PRICES OF PEARS, 1913 TO 1929

The New York farm price of pears has increased more than has the Oregon farm price. During the last four years, the New York farm price has averaged 30 per cent higher than the Oregon price.

Sources of data: 1913 to 1914, *The Agricultural Outlook,* Farmers' Bulletin 645, page 39. 1915 to 1921, *Monthly Crop Reporter:* December, 1915, page 80; December, 1917, page 131; December, 1919, page 137; volume 7, number 12, page 157. 1922 to 1923, *Weather Crops and Markets,* volume 4, number 26, page 679. 1924 to 1929, *Crops and Markets,* volume 3, number 12, page 402; volume 4, number 12, page 466; volume 6, number 12, page 473.

Prices before 1925 are the November 15 price. Prices for 1925 to 1929 are the seasonal farm price

the Oregon price. This indicates that the price of Oregon pears has apparently been more affected by high marketing costs since the World War and by the increased competition in the pear industry than has the price of New York pears.

[4] Marketing western New York pears, season 1927. By H. F. Willson and A. L. Thomas. A mimeographed report of the Bureau of Agricultural Economics of the United States Department of Agriculture in cooperation with the New York State Department of Agriculture and Markets, 1928.

Trend and distribution of total pear production in the United States

Number of pear trees, 1910, 1920, and 1925

The pear industry on the Pacific Coast has expanded rapidly during the past two decades. This has been especially true of California. California had four times as many pear trees in 1925 as in 1910, and Washington and Oregon had 41 per cent more (table 8). The number of pear trees in New York declined 11 per cent from 1920 to 1925. The total of all other States showed a marked decline in the number of pear trees. This decline has been about equal to the increase in the Pacific Coast States, so the total number of pear trees in the United States in 1925 was about the same as in 1910. The number of pear trees in the different sections of the United States in 1925 are shown in figure 11.

TABLE 8. NUMBER OF BEARING AND NON-BEARING PEAR TREES IN THE IMPORTANT PEAR-PRODUCING STATES AND IN THE UNITED STATES, 1910, 1920, AND 1925

	Number of trees * (thousands)			Per cent of United States total		
	1910	1920	1925	1910	1920	1925
California	1,809	4,484	7,397	7.5	21.7	31.9
Washington and Oregon	1,978	1,992	2,790	8.3	9.6	12.0
New York	3,644	3,746	3,332	15.2	18.1	14.4
All other States	16,544	10,477	9,679	69.0	50.6	41.7
Total United States	23,975	20,699	23,198	100.0	100.0	100.0

* Data from the *Yearbook of Agriculture* of the United States Department of Agriculture for 1927, p. 857, 1928.

FIGURE 11. NUMBER OF BEARING AND NON-BEARING PEAR TREES IN THE UNITED STATES, 1925

(Each dot represents 50,000 trees)

Pear production in the United States is largely concentrated in the Pacific Coast States and in the States that border on the Great Lakes.

Reprinted from the University of California Agricultural Experiment Station Bulletin 452 *Economic Aspects of the Apple Industry*, by S. W. Shear.

Production in important pear-producing States, 1917 to 1929

Pear production in California, Washington, and Oregon has more than doubled during the past decade (table 9 and figure 12). Production in New York remained about level until 1925. Since then it has declined

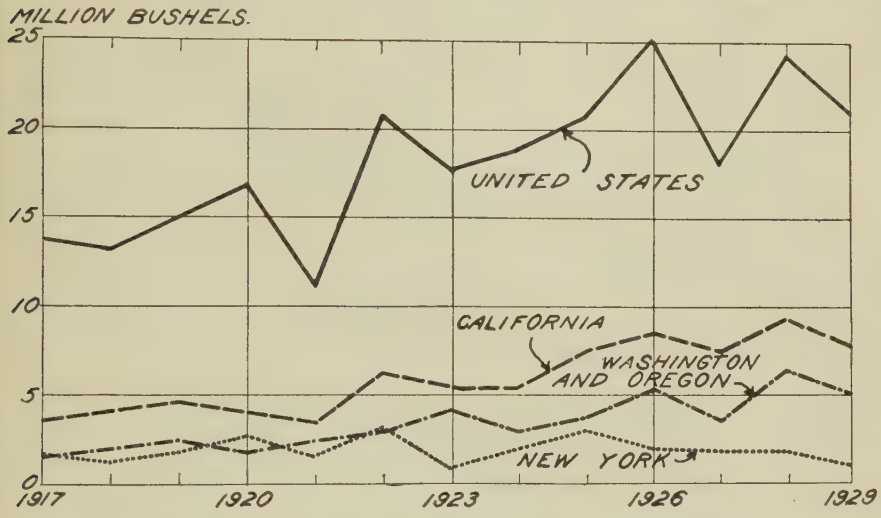

FIGURE 12. PEAR PRODUCTION FOR NEW YORK, CALIFORNIA, WASHINGTON AND OREGON, AND UNITED STATES, 1917 TO 1929

Total pear production in the United States has shown a marked upward trend, owing to rapid increase in production on the Pacific Coast. Since 1925, New York production has declined. For sources of data, see footnote to table 9

markedly. The average pear production in the United States for the four year 1926 to 1929 was 58 per cent higher than the average for 1917 to 1921. This increase has been due to the rapid expansion of production on the Pacific Coast.

TABLE 9. AVERAGE YEARLY PRODUCTION OF PEARS IN THE IMPORTANT PEAR-PRODUCING STATES AND IN THE UNITED STATES FOR 1917–1921, 1922–1925, AND 1926–1929*

	1917–1921	1922–1925	1926–1929	Per cent increase of 1926–1929 over 1917–1921
	Thousand bushels	Thousand bushels	Thousand bushels	
California	4,031	6,219	8,318	106
Washington and Oregon	2,112	3,549	5,112	142
New York	1,848	2,336	1,728	-6
All other States	6,069	7,430	7,026	16
Total United States	14,060	19,534	22,184	58

* Data for 1917 to 1922, inclusive, are taken from *Economic Aspects of the Pear Industry*, by S. W. Shear, Bulletin 452 of the University of California Agricultural Experiment Station, p. 101, 1928. Data for 1923 to 1927, inclusive, are taken from the *Yearbook of Agriculture* of the United States Department of Agriculture for 1928, p. 782, 1929. Data for 1928 and 1929 are taken from *Crops and Markets*, issued by the United States Department of Agriculture, vol. 6, no. 12, December, 1929.

Expected increases in production on the Pacific Coast

Apple production in the Northwest is near its peak.[5] This is not true of pears in the Northwest or in California. Since 1919 both the bearing acreage and the production on the Pacific Coast has increased about 10 per cent a year. It seems likely that production will increase at nearly the same rate for several years more.[6]

In 1929 California had 69,461 acres of bearing pear trees and 24,620 acres of non-bearing pear trees.[7] About 50 per cent of the California pear acreage in 1929 was under ten years of age. This means there will be a considerable increase in production from the bearing trees that have not reached full bearing as well as from the non-bearing trees coming into bearing. Judging from estimated future bearing acreage, Dr. Shear concludes that by 1932 California's production may average at least 35 per cent greater than the average production from 1926 to 1928. He also states that, judging from the age of the trees, the peak of production may not be reached by 1932.

Relation of the pear supply in the United States after August 15 to the price of New York Bartlett pears

The bulk of the California pear crop is off the markets before the New York crop arrives. On the average, 85 per cent of California pear shipments have moved from that State before September 1.[8] The Washington and Oregon crop starts moving a little ahead of the New York crop, but the bulk of the crop competes directly with the New York pear crop. On the average, two-thirds of the Washington and Oregon crop remains to be shipped after September 1. It must be remembered that it requires about two weeks for pear shipments from the Pacific Coast to reach the markets along the Atlantic Coast.

The pear supply in the United States after August 15 is one of the most important factors influencing the price of New York Bartlett pears during September (figure 13). During years when the supply after August 15 is heavy, prices are low. In 1929 the western New York f.o.b. price was high because the New York crop was short and there was unusual competition from canning factories for pears. Because of these high prices, few pears were sold on an f.o.b. basis.

Pear supplies available after August 15 have shown a definite upward trend. With the outlook for a heavier production of pears on the Pacific

[5] The agricultural outlook for 1930. U. S. Agr. Dept. Miscellaneous publication 73:50. 1930.
[6] Pacific coast pear supply and price situation. By S. W. Shear. A mimeographed report of the Division of Agricultural Economics of the College of Agriculture of the University of California. 1929.
[7] California crop report, 1928. Issued by the California Cooperative Crop Reporting Service and the United States Department of Agriculture in cooperation with the State of California Department of Agriculture. Special publication 96:44. 1929.
[8] Economic aspects of the pear industry. By S. W. Shear. Univ. California Agr. Exp. Sta. Bul. 452:57. 1928.

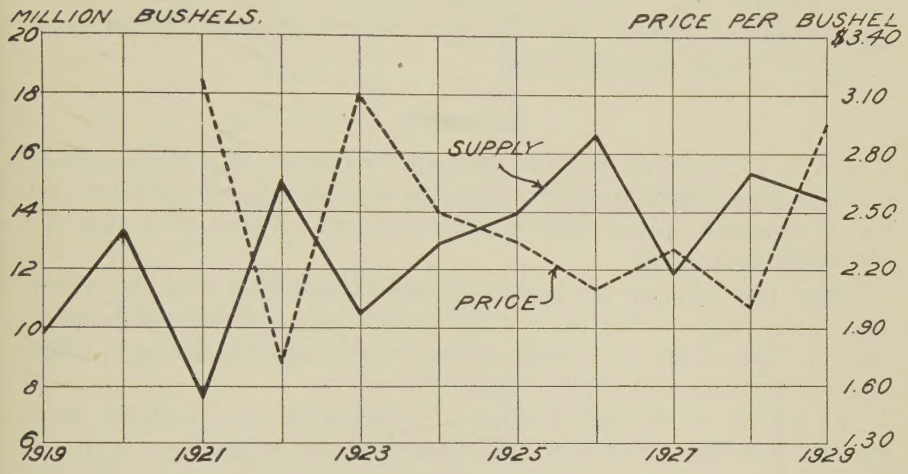

FIGURE 13. RELATION OF THE PEAR SUPPLIES IN THE UNITED STATES AFTER AUGUST 15 TO THE SEPTEMBER PRICE OF NEW YORK BARTLETT PEARS, 1921 TO 1929

When the pear supply in the United States after August 15 is large, the price of New York Bartletts is low. When the supply is small, the prices are high.
Data adapted from *Pacific Coast Supply and Price Situation*, by S. W. Shear, Mimeographed report, College of Agriculture, University of California, figure 7, 1929

Coast, this increase will probably continue and more than offset the smaller production in the Eastern States. Thus pear supplies after August 15 may be expected to be larger in the future. Unless demand is increased, this will mean lower prices for New York Bartlett pears.

Per caput supply of pears and other fruit in the United States

The per caput supply of pears in the United States for the period 1924 to 1928 was 54 per cent higher than for the period 1909 to 1913 (table 10). The total supply is calculated by subtracting from the amount produced in the United States and imported from other countries and possessions

TABLE 10. PER CAPUT SUPPLY OF FRUIT IN THE UNITED STATES, 1909 TO 1928*

(Pounds per caput per year)

Years beginning July 1	Pears	Apples	Oranges and grapefruit	Bananas
1909 to 1913	4.6	84	14	18
1914 to 1918	4.9	92	17	14
1919 to 1923	6.1	72	21	15
1924 to 1928	7.1	67	22	19

*Data for the years 1909 to 1926, inclusive, are taken from *The Apple Situation in New York State*, by G. P. Scoville, Leland Spencer, M. P. Rasmussen, J. F. Harriott, and Joseph Oskamp. Cornell Extension Bulletin 172, p. 97, 1928.

the exports to other countries and possessions. The increase in the per caput supply of pears is about the same as the increase in the per caput supply of oranges and grapefruit.

Summary

Many pear orchards in New York are located on soils which should not have been planted to fruit. With the present high cost of labor and the low price of pears, many of these orchards on poor fruit soils are not worth maintaining.

Where pear orchards are located on well-drained fruit soils and where fairly good yields can be obtained, the orchards are probably worth maintaining. One of the outstanding reasons for the unprofitableness of pears in New York has been the low yield.

The grower, in deciding whether to maintain his pear orchard, must consider that New York pears will face increased competition from the Pacific Coast. The increased production on the Pacific Coast will probably more than offset the decrease in production in the other States.

The returns per acre from apples has been double that of pears in western New York. The higher returns from apples has caused growers to set apple trees instead of pear trees. Practically no pear trees have been set in western New York since 1920.

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